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# Forage Brassica Trial

Heather Darby
*University of Vermont*, heather.darby@uvm.edu

Hannah Harwood
*University of Vermont*

Rosalie Madden
*University of Vermont*

Erica Cummings
*University of Vermont*

Susan Monahan
*University of Vermont*

***See next page for additional authors***

**Authors**
Heather Darby, Hannah Harwood, Rosalie Madden, Erica Cummings, Susan Monahan, and Amanda Gervais

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# 2011 Forage Brassica Variety Trial

Dr. Heather Darby, UVM Agronomist
Hannah Harwood, Rosalie Madden, Erica Cummings, Susan Monahan, Amanda Gervais
UVM Extension Crop and Soil Technicians

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The University of Vermont Extension

**2011 Forage Brassica Variety Trial**
**Dr. Heather Darby, University of Vermont Extension**
**Heather.Darby[at]uvm.edu**

Forage brassicas are a cool season crop and grow best during the late summer and fall months. This creates the opportunity to fill a gap in feed quality during months not optimal for perennial pasture production. Many producers are interested in extending the grazing season into late fall to improve farm viability. Brassica crops are known for their ability to provide a near-concentrate type diet late in the season, decreasing reliance on expensive imported grain for nutrient requirements. In 2011, the University of Vermont Extension Northwest Crops and Soils Team conducted a forage brassica trial in Alburgh, VT. The objective was to evaluate the yield and quality capabilities of commercially available forage brassica varieties, including radish, turnip, mustard, kale, and rape.

# MATERIALS AND METHODS

The 2011 trial was located at the Borderview Farm in Alburgh, VT, on a Benson rocky silt loam. All plots were managed with conventional tillage practices, including moldboard plow, disking, and field finishing with a drag harrow (Table 1). The experimental design was a randomized complete block with three replicates. The ten species/varieties evaluated are listed in Table 2. Plots were seeded with a Kincaid cone seeder at a rate of 8 lbs acre$^{-1}$ on 2-September. On 24-October, each plot was assessed for vigor and fall growth on a 1-5 scale, 1 being very poor and 5 being extremely vigorous. Forage brassicas were harvested by hand on 4-November to determine yield. A subsample of the forage was taken to determine quality.

**Table 1. Agronomic and trial information for the 2011 forage brassica variety trial.**

| Location | Borderview Farm-Alburgh, VT |
|---|---|
| Soil type | Benson rocky silt loam |
| Previous crop | Spring wheat |
| Tillage operations | Moldboard plow, disking, drag harrow |
| Plot size (ft.) | 6 x 20 |
| Replicates | 3 |
| Planting date | 2-Sep, 8 lbs acre$^{-1}$ |
| Harvest date | 4-Nov |

**Figure 1. Appin turnip.**

**Figure 2. T-Raptor brassica hybrid.**

**Table 2. Forage brassica varieties and their sources, 2011.**

| Variety | Species | Seed source |
|---|---|---|
| Appin | Turnip | King's Agriseed |
| Barkant | Turnip | Barenbrug |
| Bonar | Rape | King's Agriseed |
| Braco | White mustard | Preferred Seed Co. |
| Caledonia | Kale | Preferred Seed Co. |
| Dwarf Essex | Rape | Preferred Seed Co. |
| Ground Hog | Radish | Preferred Seed Co. |
| Pasja | Brassica hybrid | King's Agriseed |
| Purple Top | Turnip | Preferred Seed Co. |
| T-Raptor | Brassica hybrid | Barenbrug |

Silage quality was analyzed at Cumberland Valley Analytical Services in Hagerstown, Maryland using wet chemistry techniques. Plot subsamples were dried, ground and analyzed for crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), ash, total digestible nutrients (TDN), non-fiber carbohydrates (NFC), non-structural carbohydrates (NSC), and net energy lactation (NEL). In addition, the micronutrients calcium, phosphorus, magnesium, potassium, iron, manganese, zinc, and copper were quantified in each sample. The CP content of forages is determined by measuring the amount of nitrogen and multiplying by 6.25. The bulky characteristics of forage come from fiber. High fiber is negatively associated with forage feeding values since the less digestible portions of plants are contained in the fiber fraction. The detergent fiber analysis system separates forages into two parts: cell contents, which include sugars, starches, proteins, nonprotein nitrogen, fats and other highly digestible compounds; and the less digestible components found in the fiber fraction. The total fiber content of forage is contained in the neutral detergent fiber (NDF). Chemically, this fraction includes cellulose, hemicellulose, and lignin. Because of these chemical components and their association with the bulkiness of feeds, NDF is closely related to feed intake and rumen fill in cows. It is well documented that cows will eat more dry matter when fed forage with high fiber digestibility.

Variations in yield and quality can occur because of variations in genetics, soil, weather, and other growing conditions. Statistical analysis makes it possible to determine whether a difference among treatments is real or whether it might have occurred due to other variations in the field. All data was analyzed using a mixed model analysis where replicates were considered random effects. At the bottom of each table a LSD value is presented for each variable (e.g. yield). Least Significant Differences (LSDs) at the 10% level (0.10) of probability are shown. Where the difference between two treatments within a column is equal to or greater than the LSD value at the bottom of the column, you can be sure in 9 out of 10 chances that there is a real difference between the two values. Treatments listed in bold had the top performance in a particular column; treatments that did not perform significantly worse than the top-performer in a particular column are indicated with an asterisk. In the example below, treatment A is significantly different from treatment C but not from treatment B. The difference between A and B is equal to 400, which is less than the LSD value of 500. This means that these treatments did not differ in yield. The difference between A and C is equal to 650, which is greater than the LSD value of 500. This means that the yields of these treatments were significantly different

| Variety | Yield |
|---|---|
| A | **1600*** |
| B | 1200* |
| C | 950 |
| LSD (0.10) | 500 |

from one another. All data was analyzed using a mixed model analysis where replicates were considered random effects. The LSD procedure was used to separate cultivar means when the F-test was significant ($P < 0.10$).

## RESULTS

Seasonal precipitation and temperatures, recorded at a weather station in close proximity to the 2011 research site, are shown in Table 3. September and October of 2011 had more precipitation and higher temperatures than the 30-year average. Between the two months, average temperatures were 5.2°F warmer than the historical average. There were a total of 1,127 GDDs accumulated for the two-month growing season of forage brassicas—306 more GDDs than the 30-year average.

**Table 3. Temperature, precipitation, and Growing Degree Days (GDDs) data by month for Alburgh, VT.**

| Burlington, VT (Alburgh, VT) | September | October |
|---|---|---|
| Average temperature (°F) | 63.8 | 51.5 |
| Departure from normal | 5.8 | 4.5 |
| | | |
| Precipitation (inches) | 5.56 | 2.68 |
| Departure from normal | 2.10 | 0.10 |
| | | |
| Growing Degree Days (base 41°F) | 662 | 465 |
| Departure from normal | 79.5 | 226 |

Based on National Weather Service data from cooperative observation stations in Burlington, VT.
Historical averages are for 30 years of data (1971-2000).

Forage brassica performance was evaluated by measuring vigor, height, yield, and quality. Brassica varieties differed significantly in overall crop vigor (Table 4). Vigor was measured visually as the level of active healthy well balanced growth. A rating of 1 indicated the lowest vigor and 5 the highest level of vigor. While the trial mean for vigor (on a 1-5 scale) was 3.5, the hybrid variety Pasja had vigorous stands by late October and the highest overall rating (4.7). Plant height differed significantly as well; Appin was tallest at 7.9 inches, though this was not significantly taller than six other varieties.

**Table 4. Crop stand characteristics and dry matter yield of ten trialed forage brassicas.**

| Variety | Species | Vigor | Plant population | Height | Dry matter yield |
|---|---|---|---|---|---|
| | | 1-5 scale | in 33 cm | inches | lb acre$^{-1}$ |
| Appin | Turnip | 4.3* | 7.70 | **7.9*** | **1291** |
| Barkant | Turnip | 4.2* | 10.2 | 6.2* | 1275 |
| Bonar | Rape | 3.7* | 6.60 | 6.9* | 703 |
| Braco | White mustard | 3.7* | 4.00 | 6.8* | 902 |
| Caledonia | Kale | 1.3 | 2.00 | 6.2* | 1082 |
| Dwarf Essex | Rape | 2.8 | 7.10 | 4.7 | 801 |
| Ground Hog | Radish | 3.0 | 3.20 | 6.3* | 774 |
| Pasja | Brassica hybrid | **4.7*** | 7.00 | 7.2* | 1161 |
| Purple Top | Turnip | 3.7* | **14.3** | 5.2 | 1155 |
| T-Raptor | Brassica hybrid | 3.7* | 8.30 | 5.2 | 766 |
| LSD (0.10) | | 1.1 | 3.4 | 1.7 | NS |
| Trial mean | | 3.5 | 7.0 | 6.3 | 991 |

Treatments indicated in **bold** had the top observed performance.
* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
NS – No significant difference was determined between treatments.

Though there was no significant difference in dry matter yield by variety, the highest-yielding variety was the turnip Appin with 1291 lbs acre$^{-1}$ (Table 4; Figure 3). This was 300 lbs acre$^{-1}$ greater than the trial average. All yields were relatively low compared to past years, with a trial average of 991 lbs acre$^{-1}$ on a dry matter basis. There were several management and environmental factors that led to below average yields. Dry matter yields did not differ statistically by variety. Overall, yields were almost half of the 2010 forage brassica trial. Low yields were primarily due to late planting. In 2011, the forage brassicas were planted in early September approximately 2 weeks later than the 2010 trial.

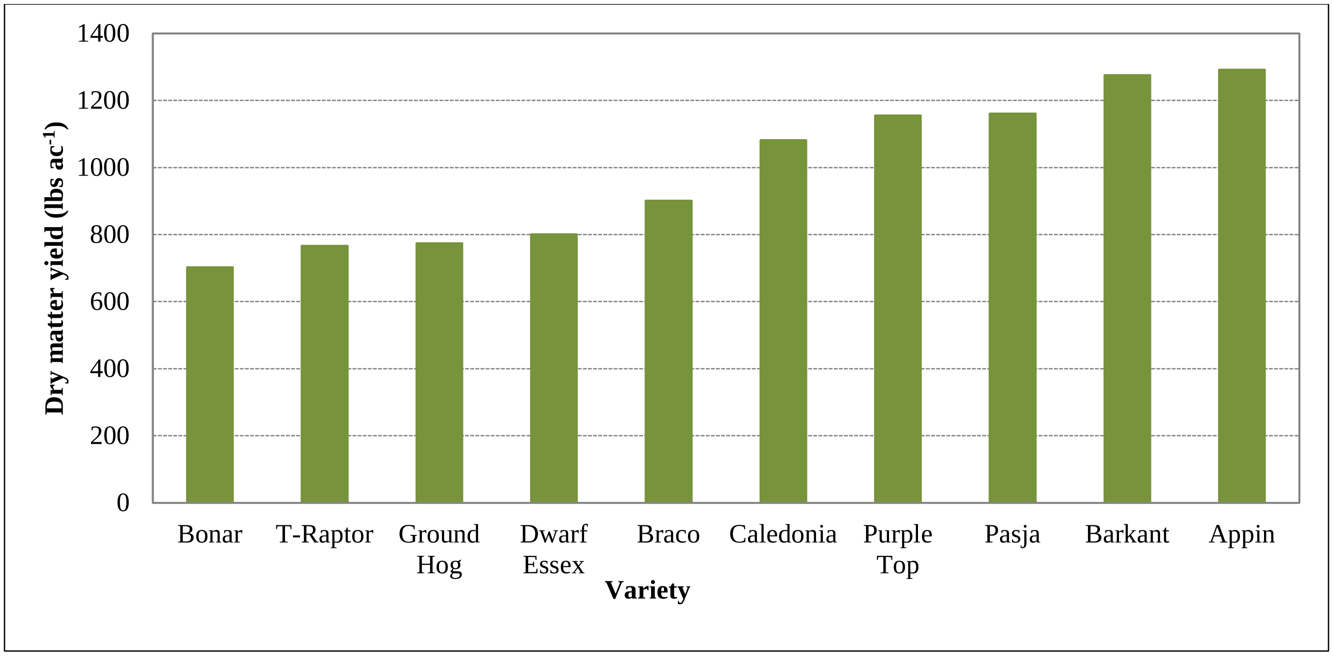


**Figure 3. Dry matter yields for forage brassicas.** ***There was no significant difference among varieties.***

**Table 5. Feed quality indicators of trialed forage brassicas.**

| Variety | Crude protein | ADF | NDF | Ash | TDN | NFC | NSC | NeL |
|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | % | % | % | Mcal $lb^{-1}$ |
| Appin | 16.8 | 15.1 | 17.2 | 16.5 | 66.9 | 48.1 | 22.9 | 0.69 |
| Barkant | 15.5 | 14.8 | 17.0 | 15.9* | 67.1 | 50.3* | 24.4 | 0.69 |
| Bonar | 17.4 | 13.9 | 16.3 | 15.3* | 69.1 | 47.4 | 23.2 | 0.72 |
| Braco | 18.5 | 16.5 | 18.0 | 18.3 | 65.1 | 43.7 | 15.6 | 0.67 |
| Caledonia | **21.5*** | **12.1** | **13.6** | 16.3 | 68.6 | 47.4 | 23.3 | 0.71 |
| Dwarf Essex | 17.2 | 13.6 | 15.5 | **13.7*** | **71.1** | 51.7* | 26.7* | **0.74** |
| Ground Hog | 20.1* | 15.6 | 16.7 | 17.7 | 66.2 | 44.0 | 16.0 | 0.69 |
| Pasja | 16.0 | 14.3 | 17.0 | 16.7 | 66.9 | 48.9 | 23.9 | 0.69 |
| Purple Top | 15.7 | 14.8 | 16.0 | 16.3 | 67.5 | 50.7* | 25.9* | 0.70 |
| T-Raptor | 15.4 | 12.7 | 15.4 | 14.1* | 70.3 | **53.5*** | **28.0*** | 0.73 |
| LSD (0.10) | 2.9 | NS | NS | 2.4 | NS | 3.4 | 3.5 | NS |
| Trial mean | 17.4 | 14.4 | 16.3 | 16.1 | 67.9 | 48.6 | 23.0 | 0.70 |

Treatments indicated in **bold** had the top observed performance.
* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
NS – No significant difference was determined between treatments.

Forage brassica varieties differed in several quality parameters (Table 5). Crude protein differed significantly by variety, with the highest concentrations in the kale variety Caledonia and the tillage radish Ground Hog. Crude protein values were between 15 and 22% for all varieties (Figure 4).

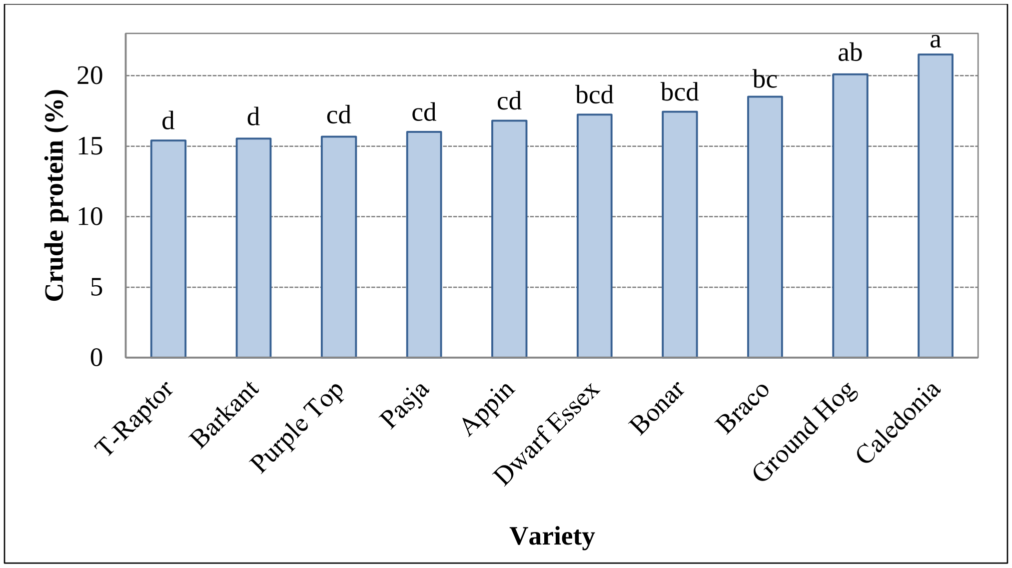


**Figure 4. Crude protein values for forage brassicas.** ***Varieties with the same letter did not differ significantly (p=0.10).***

Fiber content (ADF and NDF) of the forage brassica were not statistically different among the varieties. The average NDF and ADF concentrations were 16.3 and 14.4, respectively. Overall the fiber concentrations of forage brassica are very low compared to other grazed forage. For example, spring perennial pasture often have NDF concentrations of 33% or higher. Total digestible nutrients were also not significant by variety, though TDN decreases as ash levels increases. Non-fiber carbohydrates, mainly starches, differed significantly by variety and were highest in T-Raptor (53.5%), though this was not significantly higher than Dwarf Essex, Purple Top, or Barkant. T-Raptor also had the highest percentage of NSC (28.0%), a measurement closely linked to NFC. Net energy of lactation was highest in Dwarf Essex rape (0.74 Mcal $lb^{-1}$). The ten forage brassicas harvested were also evaluated for micronutrient levels, with statistically significant differences in calcium, phosphorus, magnesium, and potassium by variety (Table 6). The micronutrients iron, manganese, zinc, and copper did not differ statistically by variety.

**Table 6. Micronutrient levels of forage brassicas in the variety trial.**

| Variety | Ca | P | Mg | K | Fe | Mn | Zn | Cu |
|---|---|---|---|---|---|---|---|---|
| | % | % | % | % | ppm | ppm | ppm | ppm |
| Appin | 2.9 | **0.57*** | 0.13* | 4.2* | 335 | 32.3 | 32.3 | 10.3 |
| Barkant | 2.7 | 0.50* | 0.13* | 4.0* | 390 | 36.7 | 28.3 | 8.3 |
| Bonar | 2.4 | 0.50* | **0.15*** | 3.4 | 606 | 40.7 | 34.0 | **10.7** |
| Braco | **3.5*** | 0.56* | 0.14* | 3.8* | 541 | 42.0 | 29.3 | 8.3 |
| Caledonia | 2.6 | 0.51* | 0.10 | **4.4*** | 309 | 37.0 | 30.3 | 8.7 |
| Dwarf Essex | 2.5 | 0.47 | 0.12 | 3.1 | 431 | 38.0 | 27.0 | 9.0 |
| Ground Hog | 3.4* | 0.54* | 0.13* | 4.0* | 502 | 39.7 | 28.7 | 8.7 |
| Pasja | 2.8 | 0.45 | 0.11 | 4.0* | 618 | **46.3** | 31.3 | 10.0 |
| Purple Top | 3.0 | 0.48 | 0.13* | 3.6 | **667** | 40.3 | **37.0** | 9.7 |
| T-Raptor | 2.6 | 0.42 | 0.12 | 3.3 | 426 | 42.3 | 31.7 | 8.3 |
| LSD (0.10) | 0.5 | 0.07 | 0.02 | 0.6 | NS | NS | NS | NS |
| Trial mean | 2.8 | 0.50 | 0.13 | 3.8 | 483 | 39.5 | 31.0 | 9.2 |

Treatments indicated in **bold** had the top observed performance.
* Treatments indicated with an asterisk did not perform significantly lower than the top-performing treatment in a particular column.
NS – No significant difference was determined between treatments.

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